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Then we have $QA=12$, $QC=10$, 4=radius of arc s', $4\sqrt{3}/3$=radius of arc s. $8\pi/3-4\sqrt{3}$=area of segment ABs', $16\pi/9-4\sqrt{3}/3$=area of ABs. $v=16.2\sqrt{3}.\pi/6$=volume generated by either segment revolving about its diameter, $2\sqrt{3}$ being the projection of AB on the axis.

Put V and V' for the volumes generated respectively by the segments ABs and ABs' revolving about QQ. Then apply the theorem: If a plane figure exterior to two parallel lines in its plane revolve in succession about each of them as axes, the difference between the volumes of the solids thus generated is equal to the area of the generating figure multiplied by 2π times the distance between the axes. Thus $V-v=(16\pi/9-4\sqrt{3}/3).2\pi.12$, $V'-v=(8\pi/3-4\sqrt{3}).2\pi.10$, $V-V'=16\pi(9\sqrt{3}-2\pi)/3=155.9113$ cubic inches=required volume.

* * *

PROBLEMS FOR SOLUTION.

ALGEBRA.

380. **Proposed by J. K. ELWOOD, Superintendent Lucas Public Schools, Lucas, Kansas.**

A and B set out to walk around a cinder path a mile in circumference, and walk 3 hours, A walking 8 miles farther than B. Each reduced his rate one mile per hour at the end of the first hour, and again one mile per hour at the end of the second hour, his speed being otherwise uniform. They start in the same direction, but 12 minutes after A has passed B the third time he turns and walks in the other direction until 6 minutes after he has met B the third time, when he returns to his original direction, and overtakes B four times more. Determine their initial velocities. Illustrate by a time-table.*

381. **Proposed by S. A. COREY, Hiteman, Iowa.**

A, B, and C simultaneously make assignments of their property for the benefit of their creditors. The assets of A, B, and C were d, e, and q, respectively.

A's indebtedness as principal was a; A's indebtedness as surety for B was g; A's indebtedness as surety for C was h; A's indebtedness as surety for B and C jointly was i, (*i. e.*, B was surety for C, and A, in turn, was surety for B).

B's indebtedness as principal was j; B's indebtedness as surety for A was k; B's indebtedness as surety for C was l.

C's indebtedness as principal was m; C's indebtedness as surety for A was n; C's indebtedness as surety for B was p.

The law requires the surety to pay only such a portion of the debt as his principal cannot pay. What is the amount of the legal indebtness of each?

382. **Proposed by C. E. FLANAGAN, Wheeling, West Virginia.**

A few days ago I deduced the following formula for finding the value of the unknown quantity in a cubic equation having the form: $x^3+3A^2x=B$.

Let $C=\sqrt{\frac{2B}{A^3}+1}-1$. Then, $x=\frac{2B}{A^2(C^2+12)}+\frac{AC}{4}$.

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* This problem is a variation of one by Todhunter. George H. Taber, of Pittsburgh, Pennsylvania, is responsible for it.

It is required to show: (1) How this formula was derived; (2) Under what conditions does it give exact results; (2) In general, what is its degree of approximation; (4) If possible, modify it so that it will always give exact results; (5) If it cannot be so modified show why.

GEOMETRY.

409. Proposed by S. LEFSCHETZ, Ph. D., University of Nebraska.

The sides of a triangle being in arithmetic progression, a and a' being, respectively, the smallest and largest sides; r, R the radii of the inscribed and circumscribed circles. To prove that $6Rr=aa'$.

410. Proposed by A. H. HOLMES, Brunswick, Maine.

Given a focus and two tangents to an ellipse, prove that the locus of the foot of the normal corresponding to either tangent is a straight line.

411. Proposed by C. N. SCHMALL, New York City.

$ABCD$ is a rectangle of known sides. BC being produced indefinitely, it is required to draw a straight line from A cutting CD and BC in X and Y, respectively, so that the intercept XY may be equal to a given straight line.[*] (Unsolved in *Educational Times.*)

CALCULUS.

331. Proposed by T. H. GRONWALL, Ph. D., C. E., 912 Schiller Building, Chicago, Illinois.

To show that:

$$(1)\ \frac{d^n}{dx^n}\left(\frac{\sin x}{x}\right)=\frac{1}{x^{n+1}}\int_0^x y^n \sin\left(y+\frac{n+1}{2}\pi\right)dy,$$

$$(2)\ \frac{d^n}{dx^n}\left(\frac{1-\cos x}{x}\right)=\frac{1}{x^{n+1}}\int_0^x y^n \sin\left(y+\frac{n}{2}\pi\right)dy.$$

332. Proposed by WILLIAM MARSHALL, Purdue University.

Find the exact or approximate value of the integrals, (a is constant),

$$(1)\ \int_1^\infty \sin(2x+a\log x)\frac{dx}{x^{3/4}};\qquad (2)\ \int_1^\infty \cos(2x+a\log x)\frac{dx}{x^{3/4}}.$$

333. Proposed by C. N. SCHMALL, New York City.

Evaluate $\int\int\int\sqrt{\frac{1-(x+y^2+z^2)}{1+x^2+y^2+z^2}}\,dx\,dy\,dz$, where $x^2+y^2+z^2>1$.

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[*] This problem is No. 16,766 in the *Educational Times.* It was proposed by D. Biddle, who, finding that no solutions of it appeared after a time, gave himself what he calls "An Easy Method of Approximating to a Correct Solution." This appeared in the issue of April 1, 1912, page 180. Mr. Biddle gives a few remarks on the problem in which he says that it is one of the many problems discussed in a paper by Prof. R. C. Archibald, of Brown University, entitled "Discussion and History of Certain Geometrical Problems of Heraclitus and Appollonius." He further says that the solution given there involves curves which are beyond the scope of "ruler and compass." He also refers to a solution by the hyperbola given in the *Educational Times Reprint*, Volume XX, New Series, page 37. The paper of Professor Archibald was read before the Edinburgh Mathematical Society on June 10, 1910.

My object in proposing the problem here is to show that it permits of a very simple solution by *Euclidean Geometry, i. e.*, by ruler and compasses only. The problem is very important and interesting, and deserves the attention of all geometricians.